ANNUAL TECHNICAL PROGRESS REPORT

Report Title:	Field Demonstration of a Membrane Process to Recover Heavy Hydrocarbons and to Remove Water from Natural Gas
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Disclaimer

Abstract

The objective of this project is to design, construct and field demonstrate a membrane system to recover natural gas liquids (NGLs) and remove water from raw natural gas. To convince industry users of the efficiency and reliability of the process, we plan to conduct an extended field test to demonstrate system performance under real-world conditions.

The membrane system has been designed and fabricated by Membrane Technology and Research, Inc. (MTR). The MTR membrane system and the compressor are now onsite at BP's Pascagoula, MS plant. The plant is undergoing a very significant expansion and the installation of the membrane unit into the test location is being implemented, albeit at a slower rate than we expected. The startup of the system and conducting of tests will occur in the next six months, depending on the availability of the remaining budget. In the interim, significant commercial progress has been made regarding the introduction of the NGL membrane and systems into the natural gas market.

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INTRODUCTION

The objective of this project is to design, construct and field demonstrate a membrane system to recover natural gas liquids (NGLs) and remove water from raw natural gas. To convince industry users of the efficiency and reliability of the process, we plan to conduct an extended field test to demonstrate system performance under real-world conditions.

The system has been designed and fabricated by Membrane Technology and Research, Inc. (MTR) and will be installed and operated at BP's Pascagoula, MS plant. The Gas Research Institute will partially support the field demonstration and BP will help install the unit and provide onsite operators and utilities. The gas processed by the membrane system will meet pipeline specifications for dew point and Btu value and can be delivered without further treatment to the pipeline. Based on data from prior membrane module tests, the process is likely to be significantly less expensive than glycol dehydration followed by propane refrigeration, the principal competitive technology. At the end of this demonstration project, the process will be ready for commercialization. A commercialization plan will be developed during this project; the plan may involve collaboration with other companies already servicing the natural gas processing industry.

EXECUTIVE SUMMARY

The MTR membrane system and the compressor are now onsite in BP's Pascagoula, MS plant. The plant is undergoing a very significant expansion and the installation of the membrane unit into the test location is being implemented, albeit at a slower rate than we expected. The startup of the system and conducting of tests will occur in the next six months, depending on the availability of the remaining budget. Significant commercial progress has been made in the interim on the introduction of the NGL membrane and systems into the natural gas market.

EXPERIMENTAL

No experiments were performed during this reporting period.

RESULTS AND DISCUSSION

The work accomplished during the period January 1 to December 31, 2003 is summarized by task below.

Task 4.0 Develop Field Test Plan

Based on the total available budget at the time of shipment of the system to the site, we will determine the extent and length of the testing that can be performed. We anticipate a testing period of four to six months at this time.

Table 1 shows the field test plan as envisioned at this time. The table gives a broad outline of the activities planned for the period of operation at the Pascagoula facility. Our previous experience in performing such field demonstrations has shown that variation of key parameters over a wide range

is typically not possible due to the potential disruption in operations at the client facility. Therefore, the pressure and flow rate variation ranges shown in Table 1 are estimates based on our initial assessments and will have to be confirmed with onsite personnel.

Table 1. Test Plan for the NGL Field Demonstration

Month	Testing Protocol	MTR Personnel Involvement	Site Personnel Involvement
1	Startup and solution of teething issues in the unit. Initial testing at plant available conditions.	Yes (1 week); daily data collection and analysis of all key streams	Daily data collection, including pressure, temperature, and flow rate; weekly data collection for gas composition of key streams
2	Parametric testing: variation in pressure and flow rate	Yes (1 week); pressure variation range: 500 – 1000 psia; flow rate variation range: 1-3 MMscfd	Daily data collection, including pressure, temperature; and flow rate; weekly data collection for gas composition of key streams
3	Continuous operation at plant available conditions	No	Daily data collection, including pressure, temperature; and flow rate; weekly data collection for gas composition of key streams
4	Continuous operation at plant available conditions	Yes (1 week); daily data collection and analysis of all key streams	Daily data collection, including pressure, temperature; and flow rate; weekly data collection for gas composition of key streams
5	Continuous operation at plant available conditions	No	Daily data collection, including pressure, temperature; and flow rate; weekly data collection for gas composition of key streams
6	Parametric testing: variation in pressure and flow rate	Yes (1 week); pressure variation range: 500 – 1,000 psia; flow rate variation range: 1-3 MMscfd	Daily data collection, including pressure, temperature; and flow rate; weekly data collection for gas composition of key streams

Task 5.1 Prepare Membranes and Modules

All required membrane modules were fabricated and installed into the system, which is now located in the BP plant in Pascagoula, MS. MTR internal part numbers and quality assurance data for these modules were listed in the 2002 Annual Report.

Task 5.2 Designs and Construct Field Demonstration System

The field demonstration system has been shipped to the site and is currently being installed with the compression and its accessories into the Pascagoula, MS facility.

Task 5.3 Install Systems at Site/Initial Evaluation

The installation of the unit at the facility has been slowed by the fact that the Pascagoula plant is undergoing a major expansion in processing capacity. Our project has therefore been delayed, but work on installation of the motor starters and control system of the compression and membrane unit has been completed.

Task 5.4 Operate System Continuously

Activity will begin after completion of installation.

Task 5.5 Survey Industry Users/Analyze Economics

As mentioned in the 2002 annual report, we have identified the following three applications as focus areas for commercialization of the technology.

1. Fuel gas conditioning (gas engines and turbines)
2. NGL recovery from rich associated gas streams (up to 15 MMscfd)
3. Gas processing for dew point control (up to 20 MMscfd)

We continue to pursue the development of these applications and have acquired significant insights in both the technical and marketing areas. Based on these insights, MTR and ABB, our commercialization partner in this product area, have developed various strategies to address what we have learned are key requirements of the customers. These strategies are listed below.

- Development of a standardized layout and membrane skid to lower repetitive engineering costs and to develop essentially reusable systems.
- Detailed development of system package specifications to allow rapid transfer of information to potential clients.
- Development of a network of fabrication shops and contacts to minimize building costs and accelerate delivery schedules.

Task 5.6 Develop Commercialization Plan

In pursuing the commercialization of the technology, we determined that several key issues had to be tackled to be successful in pushing the technology into general use in the natural gas market. These issues include but may not be limited to:

1. Access to markets and consistent collection of valid qualified leads and prospects related to the focus applications.

2. Ability to provide a technically adequate solution for the problem.
3. Ability to inspire confidence in the customer and an adequate comfort level with the new technology.
4. Ability to correctly price the systems to meet the customer expectations and expected competition.
5. Ability to deliver systems in the shortest possible time from placement of order.
6. Ability to predict and control costs to ensure profitability.
7. Ability to provide the final client with innovative financing methods, including leases and processing fees.

In 2002, we signed a marketing agreement with ABB–Randall Gas Technologies to promote and commercialize MTR's membrane products for the natural gas industry. Since then, MTR and ABB personnel have been working closely to facilitate the transfer of technology under the agreement and have built a very good rapport. Commercialization of the products related to this project is the first priority for the alliance and key steps have already been taken in this direction. Key accomplishments during 2003 are listed below.

1. Standard membrane packages were finalized and costing was confirmed.

2. Customer quotes and proposals were standardized.

3. ABB engineering, process, and sales groups were trained in the relevant features and benefits of the MTR technology and the use of the membrane simulation package.

4. Discussions and meetings were held with Caterpillar and Waukesha Engine in 2003. The conclusion from these meetings was that gas engine companies are aware of the issues of using raw heavy gas as fuel but are not interested in incorporating cleanup solutions, such as membranes, in their packages because that would increase costs and potentially reduce their replacement parts business.

5. Meetings were held with several key equipment packagers who install and operate equipment that uses the gas engines. This group was more receptive to the idea, but only in those cases where they were ultimately responsible for the operation and maintenance of the equipment at a fixed cost (as an operating fee or lease). Use of a fuel gas conditioning unit (FGCU) would lower their expenses and increase profits, and therefore may be interesting to them.

6. We have made direct customer contact within several large gas and pipeline companies to introduce the products and to determine possible multiple unit installations in their facilities. The vice president of business development for ABB–Randall Gas Technologies has been introducing membranes to contacts all over the world. Several inquiries have resulted and are being pursued.
7. During 2003, the Wartsila/PGS fuel gas conditioning unit (FGCU) was fabricated and delivered to the floating production, storage, and offloading unit (FPSO) in the North Sea. The system has been operational since late fourth quarter of 2003.

8. Also in November 2003, MTR sold a FGCU to Dominion Resources, Canada. This FGCU will process about 2 MMscfd and will reduce levels of both heavy hydrocarbons and hydrogen sulfide in the fuel gas for a set of gas engines. The $380,000 system will be delivered in March 2004.

9. MTR's marketing efforts have been focused on the best utilization of our website, www.mtrinc.com.

Task 6.0 Final Report/Conference Presentation

ABB and MTR are slated to make two conference presentations in 2004. The first will be at the prestigious Laurance Reid Gas Conditioning Conference in Oklahoma; the second will be at the Annual GPA Conference in New Orleans.

CONCLUSION

The membrane system has been designed and fabricated by Membrane Technology and Research, Inc. (MTR). The MTR membrane system and the compressor are now onsite at BP's Pascagoula, MS plant. The plant is undergoing a very significant expansion and the installation of the membrane unit into the test location is being implemented, albeit at a slower rate than we expected. The startup of the system and conducting of tests will occur in the next six months, depending on the availability of the remaining budget. Significant commercial progress has been made in the interim on the introduction of the NGL membrane and systems into the natural gas market.

REFERENCES

None cited.